CLAIMS

What is claimed is:

1. An apparatus for controlling the operation of a continuously variable transmission (CVT), comprising:

a programmable controller; and

means associated with said controller for mapping rate of change of ratio to clamping pressure and/or differential pressure between pulleys in said CVT.

2. An apparatus as recited in claim 1, further comprising a hydraulic servo control system adapted for control by said programmable controller and for control of clamping pressure and differential pressure between pulleys in said CVT.

3. An apparatus for controlling the rate of change ratio in a continuously variable transmission (CVT), comprising:

a programmable controller;

programming associated with said controller for mapping rate of change of ratio to clamping pressure and/or differential pressure between pulleys in said CVT.

4. An apparatus as recited in claim 3, further comprising a hydraulic servo control system adapted for control by said programmable controller and for control of clamping pressure and differential pressure between pulleys in said CVT.

5. An apparatus for controlling the operation of a continuously variable transmission (CVT), comprising:

a programmable controller;

an algorithm or map associated with said controller, wherein said algorithm or map determines clamping pressure and/or differential pressure level between pulleys in said CVT for achieving a desired rate of change in ratio in said CVT.

6. An apparatus as recited in claim 5, further comprising a hydraulic servo control system adapted for control by said programmable controller and for control of

clamping pressure and/or differential pressure between pulleys in said CVT.

7. An apparatus for optimizing the operation of a continuously variable transmission (CVT), comprising:

a control computer; and

programming associated with said control computer for carrying out the operations of controlling primary and secondary pulley pressure of a CVT to achieve a commanded clamping pressure in response to an input torque command and commanded ratio rate or shift velocity based on a mapping of empirical data relating pressure, ratio rate, and torque.

8. An apparatus as recited in claim 7, further comprising a hydraulic servo control system adapted for control of said primary and second pulley pressure in response to said control computer.

9. An apparatus for optimizing the operation of a continuously variable transmission (CVT), comprising:

(a) a control computer; and

(b) programming associated with said control computer for

(i) accessing a map of the relationship between pressure of a CVT and rate of change of ratio to transmit a given amount of torque, and

(ii) controlling primary and second pulley pressure of the CVT to achieve a commanded clamping pressure for commanded torque and ratio rate based on said map.

10. An apparatus as recited in claim 9, further comprising a hydraulic servo control system adapted for control of said primary and second pulley pressure in response to said control computer.

11. An apparatus for optimizing the operation of a continuously variable transmission (CVT), comprising:

(a) a control computer; and

(b) programming associated with said control computer for carrying out the operations of controlling primary and secondary pulley pressures of the CVT to control the ratio rate and/or ratio and clamping pressure of the CVT based on an equilibrium ratio map of the CVT and the pressure relationship between the ratio rate of the CVT and the distance between the point corresponding to the current states of the CVT and the projection of this point onto said equilibrium ratio map.

12. An apparatus as recited in claim 11, further comprising a hydraulic servo control system adapted for control of said primary and second pulley pressure in response to said control computer.

13. An apparatus for controlling the operating of a continuously variable transmission (CVT) comprising:

a servo control system;

said servo control system configured to control clamping pressure and differential pressure between primary and secondary pulleys in the CVT;

a control computer; and

programming associated with said control computer for controlling said servo control system to achieve commanded clamping pressure and/or differential pressure between the primary and secondary pulleys based on a mapping of rate of change of ratio of said CVT to said clamping pressure and/or differential pressure between pulleys.

14. A hybrid electric vehicle, comprising:

a continuously variable transmission (CVT):

an internal combustion engine coupled to the CVT;

an electric motor coupled to the output of the internal combustion engine;

a system controller configured to operate said motor simultaneously with said engine and apply motor torque to said engine output to maintain engine power or torque output substantially along a predetermined operating line;

said system controller further configured to control rate of change of ratio of said continuously variable transmission;

wherein said system controller varies acceleration and deceleration of said vehicle by varying motor torque and rate of change of ratio of said continuously variable transmission; and

means associated with said controller for mapping rate of change of ratio to clamping pressure and/or differential pressure between pulleys in said CVT.

15. A hybrid electric vehicle as recited in claim 14, further comprising a hydraulic servo control system adapted for control by said system controller and for control of clamping pressure and differential pressure between pulleys in said CVT.

16. A hybrid electric vehicle, comprising:

a continuously variable transmission (CVT):

an internal combustion engine coupled to the CVT;

an electric motor coupled to the output of the internal combustion engine;

a system controller configured to operate said motor simultaneously with said engine and apply motor torque to said engine output to maintain engine power or torque output substantially along a predetermined operating line;

said system controller further configured to control rate of change of ratio of said continuously variable transmission;

wherein said system controller varies acceleration and deceleration of said vehicle by varying motor torque and rate of change of ratio of said continuously variable transmission; and

programming associated with said system controller for mapping rate of change of ratio to clamping pressure and/or differential pressure between pulleys in said CVT.

17. A hybrid electric vehicle as recited in claim 16, further comprising a hydraulic servo control system adapted for control by said system controller and for control of clamping pressure and differential pressure between pulleys in said CVT.

18. A hybrid electric vehicle, comprising:

a continuously variable transmission (CVT):

an internal combustion engine coupled to the CVT;

an electric motor coupled to the output of the internal combustion engine;

a system controller configured to operate said motor simultaneously with said engine and apply motor torque to said engine output to maintain engine power or torque output substantially along a predetermined operating line;

said system controller further configured to control rate of change of ratio of said continuously variable transmission;

wherein said system controller varies acceleration and deceleration of said vehicle by varying motor torque and rate of change of ratio of said continuously variable transmission; and

an algorithm or map associated with said system controller, wherein said algorithm or map determines clamping pressure and/or differential pressure level between pulleys in said CVT for achieving a desired rate of change in ratio in said CVT.

19. A hybrid electric vehicle as recited in claim 18, further comprising a hydraulic servo control system adapted for control by said programmable controller and for control of clamping pressure and differential pressure between pulleys in said CVT.

20. A hybrid electric vehicle, comprising:

a continuously variable transmission (CVT):

an internal combustion engine coupled to the CVT;

an electric motor coupled to the output of the internal combustion engine;

a system controller configured to operate said motor simultaneously with said engine and apply motor torque to said engine output to maintain engine power or torque output substantially along a predetermined operating line;

said system controller further configured to control rate of change of ratio of said continuously variable transmission;

wherein said system controller varies acceleration and deceleration of said vehicle by varying motor torque and rate of change of ratio of said continuously variable transmission; and

programming associated with said system controller for carrying out the operations of controlling primary and secondary pulley pressure of a CVT to achieve a commanded clamping pressure in response to an input torque command and commanded ratio rate or shift velocity based on a mapping of empirical data relating pressure, ratio rate, and torque.

21. A hybrid electric vehicle as recited in claim 20, further comprising a hydraulic servo control system adapted for control of said primary and second pulley pressure in response to said system controller.

22. A hybrid electric vehicle, comprising:

a continuously variable transmission (CVT):

an internal combustion engine coupled to the CVT;

an electric motor coupled to the output of the internal combustion engine;

a system controller configured to operate said motor simultaneously with said engine and apply motor torque to said engine output to maintain engine power or torque output substantially along a predetermined operating line;

said system controller further configured to control rate of change of ratio of said continuously variable transmission;

wherein said system controller varies acceleration and deceleration of said vehicle by varying motor torque and rate of change of ratio of said continuously variable transmission; and

programming associated with said system controller computer for

(i) accessing a map of the relationship between pressure of a CVT and rate of change of ratio to transmit a given amount of torque, and

(ii) controlling primary and second pulley pressure of the CVT to achieve a commanded clamping pressure for commanded torque and ratio rate based on said map.

23. A hybrid electric vehicle as recited in claim 22, further comprising a hydraulic servo control system adapted for control of said primary and second pulley pressure in response to said system controller.

24. A hybrid electric vehicle, comprising:

a continuously variable transmission (CVT):

an internal combustion engine coupled to the CVT;

an electric motor coupled to the output of the internal combustion engine;

a system controller configured to operate said motor simultaneously with said engine and apply motor torque to said engine output to maintain engine power or torque output substantially along a predetermined operating line;

said system controller further configured to control rate of change of ratio of said continuously variable transmission;

wherein said system controller varies acceleration and deceleration of said vehicle by varying motor torque and rate of change of ratio of said continuously variable transmission; and

programming associated with said system controller for carrying out the operations of controlling primary and secondary pulley pressures of the CVT to control the ratio rate and/or ratio and clamping pressure of the CVT based on an equilibrium ratio map of the CVT and the pressure relationship between the ratio rate of the CVT and the distance between the point corresponding to the current states of the CVT and the projection of this point onto said equilibrium ratio map.

25. A hybrid electric vehicle as recited in claim 11, further comprising a hydraulic servo control system adapted for control of said primary and second pulley pressure in response to said system controller.

26. A hybrid electric vehicle, comprising:

a continuously variable transmission (CVT):

an internal combustion engine coupled to the CVT;

an electric motor coupled to the output of the internal combustion engine;

a system controller configured to operate said motor simultaneously with said engine and apply motor torque to said engine output to maintain engine power or torque output substantially along a predetermined operating line;

said system controller further configured to control rate of change of ratio of said continuously variable transmission;

wherein said system controller varies acceleration and deceleration of said vehicle by varying motor torque and rate of change of ratio of said continuously variable transmission;

a servo control system;

said servo control system configured to control clamping pressure and differential pressure between primary and secondary pulleys in the CVT; and

programming associated with said system controller for controlling said servo control system to achieve commanded clamping pressure and/or differential pressure between the primary and secondary pulleys based on a mapping of rate of change of ratio of said CVT to said clamping pressure and/or differential pressure between pulleys.

27. A method for controlling the operation of a continuously variable transmission (CVT), comprising:

mapping rate of change of ratio to clamping pressure and/or differential pressure between pulleys in said CVT; and

controlling clamping pressure and/or differential pressure between pulleys in said CVT based on said mapping.

28. A method for controlling the operation of a continuously variable transmission (CVT), comprising:

providing a programmable controller;

providing an algorithm or map associated with said controller, wherein said algorithm or map determines clamping pressure and/or differential pressure level between pulleys in said CVT for achieving a desired rate of change in ratio in said CVT; and

providing a hydraulic servo control system adapted for control by said programmable controller and for control of clamping pressure and/or differential pressure between pulleys in said CVT.

29. A method for optimizing the operation of a continuously variable transmission (CVT), comprising:

controlling primary and secondary pulley pressure of a CVT to achieve a commanded clamping pressure in response to an input torque command and commanded ratio rate or shift velocity based on a mapping of empirical data relating pressure, ratio rate, and torque.

30. A method for optimizing the operation of a continuously variable transmission (CVT), comprising:

accessing a map of the relationship between pressure of a CVT and rate of change of ratio to transmit a given amount of torque; and

controlling primary and second pulley pressure of the CVT to achieve a commanded clamping pressure for commanded torque and ratio rate based on said map.

31. A method for optimizing the operation of a continuously variable transmission (CVT), comprising:

controlling primary and secondary pulley pressures of the CVT to control the ratio rate and/or ratio and clamping pressure of the CVT based on an equilibrium ratio map of the CVT and the pressure relationship between the ratio rate of the CVT and the distance between the point corresponding to the current states of the CVT and the projection of this point onto said equilibrium ratio map.

32. A method for controlling the operating of a continuously variable transmission (CVT) comprising:

providing a servo control system;

said servo control system configured to control clamping pressure and differential pressure between primary and secondary pulleys in the CVT; and

controlling said servo control system to achieve commanded clamping pressure and/or differential pressure between the primary and secondary pulleys based on a mapping of rate of change of ratio of said CVT to said clamping pressure and/or differential pressure between pulleys.